

PRELIMINARY DATA SUMMARY

March, 1989

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina



## CONTENTS

	<u>Page</u>
TABLE OF CONTENTS.....	1
PART I: INTRODUCTION.....	2
PART II: METEOROLOGICAL DATA.....	6
PART III: WAVE DATA.....	9
PART IV: CURRENT DATA.....	13
PART V: SUPPLEMENTAL OBSERVATIONS.....	21
PART VI: WATER LEVELS.....	23
PART VII: NEARSHORE PROFILES AND BATHYMETRY.....	26
PART VIII: SPECIAL EVENTS.....	29

## LIST OF FIGURES

<u>No.</u>		<u>Page</u>
1	FRF location map.....	3
2	Instrument locations at FRF.....	5
3	Time history of wave heights and periods.....	12
4	Water level time history .....	24
5	CRAB profiles.....	26
6	CRAB profile envelope.....	27
7	FRF bathymetry (12 Mar 89).....	28

## LIST OF TABLES

<u>No.</u>		<u>Page</u>
1	Instrument Status/Data Availability.....	4
2	Meteorological Data.....	7
3	Wave Data.....	10
4	Current Data.....	14
5	Supplemental Observations.....	22
6	Water Levels.....	25

## PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

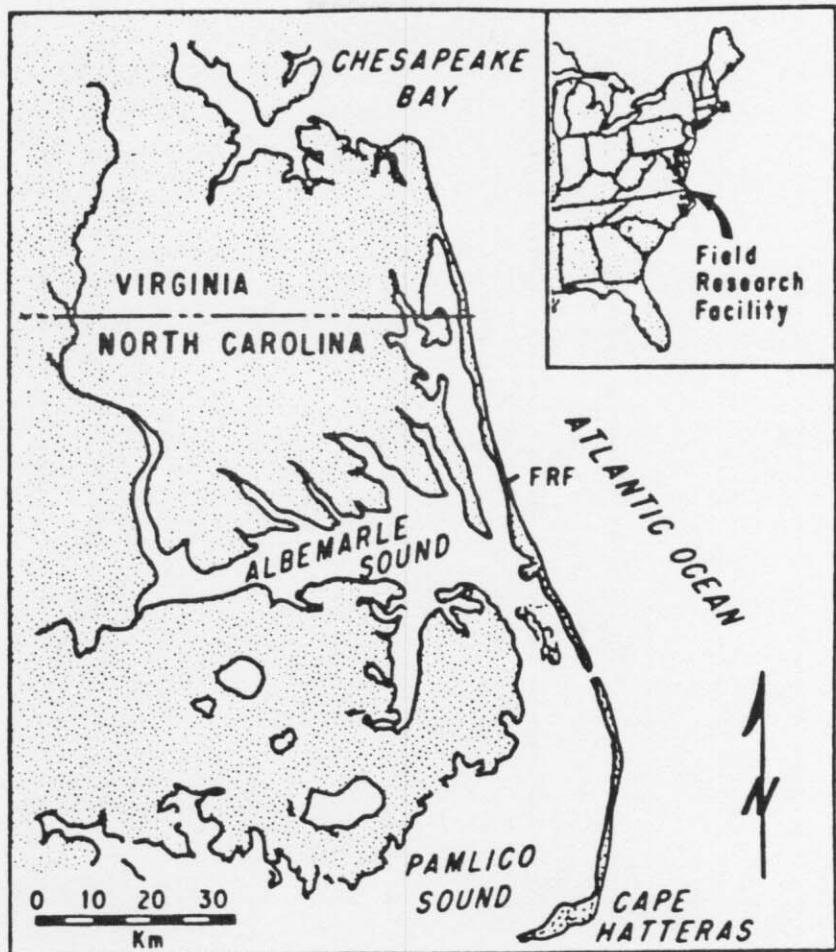


Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

MAR 1989

Gage ID	Description/Remarks	Depth at Sensor		Day of the month																																				
				1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1						
616	Barometric Pressure		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
604	Precipitation		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
624	Air Temperature		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
632	Anemometer on Laboratory Building Elevation 19 m (NGVD)		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
625	Baylor staff at station 18+60 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
679	Current meter 500 m south of FRF pier (0.6 km offshore)	see Figure 7	Gage Status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
			Data Collected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
865-1370	NOAA tide station at seaward end of FRF pier	,	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Supplemental Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

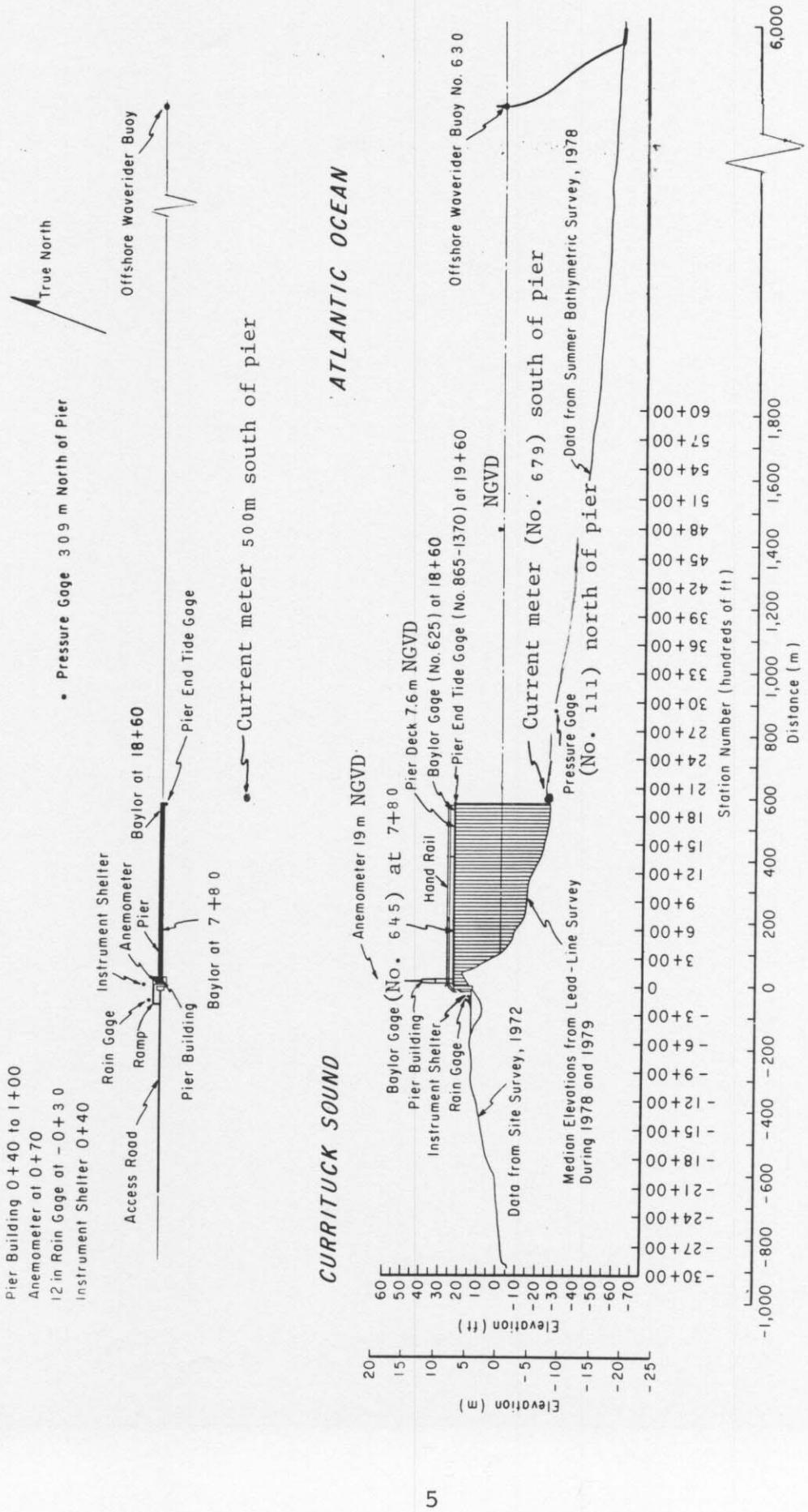


Figure 2. Instrument locations at FRF

## PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured on top of the laboratory building at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -  
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -  
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -  
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -  
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Mar 1989

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	Pressure mb	mm
1	100	5	321	3.1	1017.5	0
	700	3	303	1.3	1020.3	0
	1300	5	234	5.2	1020.6	0
	1900	3	153	5.4	1020.9	0
2	100	3	217	4.4	1021.6	0
	700	5	7	5.2	1022.3	0
	1300	7	15	7.8	1020.9	0
	1900	5	32	6.9	1019.2	0
3	100	6	41	7.5	1015.5	0
	700	5	45	8.1	1014.5	0
	1300	11	40	9.9	1012.1	19
	1900	9	25	8.9	1011.1	11
4	100	3	341	9.9	1013.1	0
	700	4	331	9.0	1015.9	0
	1300	6	309	10.1	1017.2	0
	1900	7	317	8.1	1018.9	0
5	100	5	301	7.5	1019.2	0
	700	0		6.2	1018.6	0
	1300	3	124	7.8	1016.2	0
	1900	4	185	11.2	1013.5	0
6	100	6	200	17.5	1011.4	0
	700	3	199	18.8	1009.1	0
	1300	8	348	7.7	1008.4	0
	1900	7	349	7.9	1008.4	0
7	100	10	350	6.8	1008.4	4
	700	16	355	5.2	1012.5	0
	1300	16	10	5.2	1016.5	0
	1900	17	19	4.5	1020.6	0
8	100	18	16	4.0	1021.9	4
	700	18	16	5.0	1021.9	3
	1300	17	13	6.0	1021.6	5
	1900	17	8	6.0	1021.9	8
9	100	17	11	6.0	1021.6	4
	700	17	7	5.4	1023.0	0
	1300	17	4	3.8	1023.0	0
	1900	15	4	3.3	1023.0	0
10	100	13	6	3.5	1021.9	0
	700	13	4	4.5	1021.3	0
	1300	14	2	5.5	1022.3	0
	1900	13	8	4.7	1023.3	0
11	100	12	12	5.1	1023.0	0
	700	7	18	6.3	1021.9	0
	1300	7	348	6.1	1020.6	0
	1900	2	52	5.4	1017.2	0
12	100	2	103	4.1	1014.8	0
	700	5	179	7.1	1011.8	0
	1300	6	354	12.2	1010.4	0
	1900	8	23	6.9	1015.9	0
13	100	8	37	6.2	1019.2	0
	700	5	18	5.7	1020.9	0
	1300	5	16	6.2	1019.2	0
	1900	9	64	6.9	1014.2	6
14	100	4	339	9.6	1010.4	23
	700	5	317	7.0	1012.8	0
	1300	4	329	8.6	1013.8	0
	1900	1	21	6.0	1013.1	0
15	100	4	188	7.7	1012.1	0
	700	5	188	14.5	1011.4	0
	1300	5	228	20.4	1010.8	0
			Software Error			0
16	100	5	187	14.2	1013.5	0
	700	9	354	7.9	1018.2	0
	1300	5	27	6.8	1023.3	0
	1900	2	83	6.1	1024.7	0

(Continued)

(Sheet 1 of 2)

Table 2: Meteorological Data

Mar 1989

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	mb	mm
17	100	2	33	4.2	1026.0	0
	700	3	57	7.6	1026.3	0
	1300	4	122	14.7	1025.0	0
	1900	3	176	13.4	1022.3	0
18	100	4	181	15.0	1020.9	0
	700	6	194	14.8	1018.9	0
	1300	6	193	23.3	1014.8	0
	1900	9	206	18.5	1012.1	0
19	100	5	253	14.7	1013.8	7
	700	14	356	6.0	1021.3	0
	1300	11	357	5.7	1024.7	0
	1900	8	23	5.2	1026.7	0
20	100	7	63	4.9	1027.7	0
	700	4	66	6.6	1028.0	0
	1300	4	27	9.0	1025.0	0
	1900	4	121	7.9	1019.2	0
21	100	6	175	14.8	1014.2	0
	700	7	181	16.8	1010.8	5
	1300	9	258	19.4	1009.4	5
	1900	8	359	7.5	1015.2	5
22	100	10	9	7.0	1018.2	0
	700	12	20	6.0	1021.6	0
	1300	13	9	3.8	1024.7	2
	1900	12	33	5.0	1026.3	0
23	100	12	26	6.1	1026.3	0
	700	13	25	6.5	1025.0	0
	1300	14	32	7.6	1023.3	3
	1900	11	43	8.9	1019.2	22
24	100	7	65	10.1	1016.5	15
	700	5	129	10.8	1012.8	12
	1300	7	253	13.4	1009.8	8
	1900	8	269	9.0	1013.5	0
25	100	7	270	6.8	1016.2	0
	700	6	286	7.3	1017.9	0
	1300	3	113	10.4	1018.6	0
	1900	4	176	10.9	1016.9	0
26	100	4	205	11.2	1017.9	0
	700	2	116	9.5	1019.6	0
	1300	4	33	13.6	1020.9	0
	1900	4	31	9.2	1021.6	0
27	100	2	121	9.0	1022.6	0
	700	1	153	13.5	1024.3	0
	1300	4	126	17.5	1024.0	0
	1900	6	177	18.4	1022.3	0
28	100	5	194	15.9	1022.6	0
	700	5	199	16.7	1022.6	0
	1300	6	211	23.4	1019.6	0
	1900	8	195	19.5	1016.9	0
29	100	9	213	17.4	1015.5	0
	700	9	221	17.6	1015.2	0
	1300	6	214	24.8	1013.8	0
	1900	7	191	20.7	1013.1	0
30	100	8	212	18.2	1013.5	0
	700	6	193	19.1	1013.1	0
	1300	6	186	22.2	1010.1	0
	1900	6	177	18.7	1007.4	0
31	100	7	195	19.3	1004.3	0
	700	6	209	18.8	1003.3	0
	1300	9	170	25.4	999.3	0
	1900	10	271	17.5	999.9	0
		Resultant 3		Mean 10.1	Mean 1017.5	Total 171

(Sheet 2 of 2)

### PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height  $H_{mo}$  is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period  $T_p$  is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all  $H_{mo}$  and  $T_p$  values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Mar 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m	Baylor at 18+60	Hmo,m	Pressure Gage	Hmo,m	Offshr Wvrdr	Hmo,m
1	0100	0.96	6.24	0.96	6.56	1.07	6.56	1.28	6.24
	0700	0.76	5.95	0.93	7.53	0.96	7.31	1.11	6.74
	1300	0.46	8.26	0.74	9.85	0.80	8.26	0.77	8.53
	1900	0.42	8.26	0.62	8.53	0.73	8.00	0.68	8.53
2	0100	0.29	10.67	0.56	9.48	0.63	8.53	0.65	8.83
	0700	0.23	10.67	0.52	11.13	0.60	10.67	0.61	8.83
	1300	0.92	5.33	0.92	5.33	0.99	5.12	1.05	5.45
	1900	0.88	5.12	0.89	5.33	0.93	5.12	1.11	5.02
3	0100	0.69	4.74	1.03	5.69	1.07	5.45	1.28	5.45
	0700	0.79	6.56	1.02	6.40	1.24	5.95	1.52	6.74
	1300	1.13	7.31	1.57	7.31	1.70	7.11	1.90	7.31
	1900	1.33	8.26	1.93	8.83	2.21	8.83	2.43	8.53
4	0100	1.21	8.53	1.93	10.24	1.99	10.24	1.89	9.14
	0700	1.27	6.92	1.61	8.26	1.70	9.85	1.77	7.53
	1300	1.24	11.13	1.94	10.67	2.04	9.85	1.87	9.85
	1900	1.27	13.47	1.77	13.47	1.86	13.47	1.64	9.85
5	0100	1.17	13.47	1.66	12.19	1.76	12.80	1.53	9.85
	0700	0.98	10.24	1.42	10.67	1.43	12.19	1.36	9.85
	1300	1.12	12.80	1.38	11.64	1.49	10.67	1.28	12.19
	1900	0.69	12.19	1.09	11.64	1.26	11.64	1.12	10.24
6	0100	0.44	11.13	0.78	11.64	0.95	11.13	0.89	9.85
	0700	0.35	9.85	0.66	11.13	0.77	10.24	0.77	9.14
	1300	0.93	4.83	0.64	9.14	0.61	10.24	0.87	4.20
	1900	1.46	6.74	1.50	6.09	1.71	6.74	1.86	6.40
7	0100	1.34	8.53	1.87	8.83	2.06	8.00	2.23	8.53
	0700	1.90	8.26	2.57	9.14	2.90	9.14	3.11	7.11
	1300	1.37	11.13	2.71	11.13	3.51	11.13	3.77	10.67
	1900	1.80	12.19	3.23	11.64	4.06	11.64	4.22	12.19
8	0100	1.37	10.24	2.73	12.80	3.91	12.19	3.81	11.64
	0700	1.87	10.67	3.23	10.67	4.13	10.67	4.03	9.48
	1300	1.43	11.64	2.70	8.83	3.68	11.13	3.81	10.24
	1900	1.92	9.14	3.35	9.85	3.93	10.24	4.22	11.64
9	0100	1.41	12.19	2.57	11.64	3.77	11.13	3.78	12.19
	0700	1.91	11.64	3.15	12.19	4.05	11.13	3.89	10.67
	1300	1.49	13.47	2.69	12.80	3.53	10.67	3.74	11.13
	1900	1.74	13.47	3.08	10.67	3.48	9.85	3.37	11.64
10	0100	1.48	13.47	2.60	11.64	3.07	10.67	2.89	8.83
	0700	1.62	12.80	2.69	11.13	3.09	10.67	2.86	7.11
	1300	1.42	13.47	2.62	9.85	3.05	10.67	2.94	8.26
	1900	1.66	12.80	2.71	10.67	2.97	9.48	3.01	7.11
11	0100	1.47	11.64	2.38	12.80	2.58	11.13	2.44	11.64
	0700	1.51	12.19	2.25	13.47	2.42	12.19	2.31	12.19
	1300	1.30	12.19	1.78	11.64	1.89	11.13	1.76	11.64
	1900	1.22	11.13	1.61	11.13	1.61	11.64	1.70	11.64
12	0100	0.94	11.64	1.49	10.67	1.45	10.67	1.37	11.13
	0700	0.84	11.64	1.37	10.67	1.39	11.64	1.32	11.13
	1300	0.58	11.13	1.09	11.64	1.18	11.64	1.02	11.64
	1900	0.85	11.13	1.13	10.24	1.20	10.67	1.06	10.67
13	0100	1.31	6.09	1.63	6.92	1.73	6.56	1.84	7.11
	0700	1.18	6.56	1.33	10.67	1.34	11.13	1.48	6.74
	1300	0.83	5.95	1.11	10.24	1.13	10.67	1.14	10.24
	1900	1.04	6.56	1.27	10.24	1.26	9.85	1.27	9.85
14	0100	0.98	5.69	1.18	5.22	1.26	4.92	1.28	5.02
	0700	1.02	7.53	1.32	7.53	1.51	7.76	1.49	7.53
	1300	0.67	5.82	1.03	7.76	1.05	8.83	1.14	6.56
	1900	0.67	4.74	0.94	9.48	0.91	6.74	1.01	7.11
15	0100	0.52	5.57	0.74	8.00	0.89	8.53	0.91	8.26
	0700	0.44	7.11	0.62	8.53	0.66	7.53	0.76	8.53
	1300	0.43	5.82	0.61	8.26	0.69	9.14	0.93	9.14
	1900	*	*	*	*	*	*	*	*
16	0100	0.38	5.95	0.51	8.53	0.61	8.83	0.70	7.11
	0700	0.38	7.76	0.49	8.53	0.51	8.53	0.64	8.83
	1300	*	*	0.82	5.02	0.80	4.74	0.82	4.83
	1900	*	*	0.80	5.69	0.81	5.57	0.90	5.82

\* Electronic problems

(Continued)

(Sheet 1 of 2)

Table 3: Wave Data

Mar 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80 Hmo,m	T.sec	Baylor at 18+60 Hmo,m	T.sec	Pressure Gage Hmo,m	T.sec	Offshr Wvrdr Hmo,m	T.sec
17	0100	*	*	0.64	5.12	0.65	5.45	0.74	5.33
	0700	*	*	0.54	7.31	0.56	7.31	0.57	8.53
	1300	0.34	4.57	0.50	8.26	0.53	8.53	0.56	8.53
	1900	0.29	8.00	0.46	8.00	0.51	8.53	0.58	8.53
18	0100	0.29	4.92	0.44	8.53	0.48	8.00	0.54	8.00
	0700	0.44	5.22	0.57	5.22	0.64	5.02	0.79	5.02
	1300	0.37	5.12	0.41	5.57	0.48	5.12	0.65	5.22
	1900	0.29	5.02	0.41	8.26	0.40	8.26	0.60	5.12
19	0100	0.26	5.45	0.34	8.53	0.37	8.26	0.50	5.95
	0700	1.53	5.95	1.53	6.24	1.77	5.95	1.91	5.82
	1300	1.48	6.24	1.27	6.24	1.48	6.09	1.61	6.40
	1900	1.10	7.31	1.14	8.26	1.22	7.31	1.35	8.53
20	0100	0.99	6.56	0.99	6.74	0.97	7.53	1.06	7.76
	0700	0.80	6.92	0.90	5.57	0.88	6.92	1.01	7.76
	1300	0.70	6.92	0.70	6.92	0.75	7.11	0.82	6.74
	1900	0.57	8.26	0.74	8.00	0.73	8.83	0.83	7.31
21	0100	0.61	4.66	0.75	7.31	0.72	8.53	0.98	4.13
	0700	0.68	6.56	0.86	7.11	1.01	6.92	1.38	6.24
	1300	0.53	5.12	0.63	7.53	0.72	7.31	1.10	7.31
	1900	0.70	4.57	0.97	4.41	1.01	4.49	1.09	7.53
22	0100	0.98	4.27	1.11	4.83	1.08	5.95	1.24	4.34
	0700	1.32	5.95	1.44	6.09	1.61	5.69	1.69	5.69
	1300	1.51	6.09	1.70	6.56	1.83	6.74	1.88	6.92
	1900	1.38	6.92	1.61	6.56	1.65	6.74	1.79	6.24
23	0100	1.52	6.56	1.71	6.40	1.85	6.56	1.92	6.56
	0700	1.53	6.40	2.03	6.74	2.12	6.92	2.27	6.92
	1300	1.53	7.11	2.00	7.31	2.10	6.56	2.24	6.24
	1900	1.64	8.00	2.30	8.83	2.47	8.53	2.44	8.53
24	0100	1.75	10.24	2.11	9.85	2.33	9.85	2.41	9.48
	0700	1.56	9.48	2.12	9.85	2.18	9.48	2.12	9.85
	1300	1.59	10.24	1.90	9.85	1.84	10.24	1.96	8.53
	1900	1.06	10.24	1.49	9.85	1.54	9.48	1.89	8.83
25	0100	0.74	9.14	1.06	8.83	1.10	9.14	1.10	8.26
	0700	0.60	10.67	0.89	9.48	0.89	9.14	0.98	10.24
	1300	0.68	11.13	0.92	11.13	0.97	11.64	0.88	10.24
	1900	0.49	9.48	0.66	11.13	0.71	9.48	0.78	10.67
26	0100	0.42	6.74	0.56	9.48	0.59	9.48	0.62	7.11
	0700	0.37	6.40	0.55	8.53	0.60	7.31	0.62	7.31
	1300	0.33	6.92	0.50	9.14	0.52	9.14	0.56	8.83
	1900	0.32	6.09	0.52	9.14	0.53	7.53	0.59	9.14
27	0100	0.32	9.85	0.57	8.53	0.54	10.24	0.62	11.13
	0700	0.35	9.14	0.61	9.48	0.59	9.85	0.64	8.83
	1300	0.35	8.83	0.57	9.48	0.63	9.85	0.63	9.85
	1900	0.36	9.48	0.62	9.48	0.56	8.83	0.63	7.76
28	0100	0.24	8.53	0.44	9.85	0.50	9.14	0.54	9.14
	0700	0.25	8.83	0.42	9.14	0.44	8.53	0.51	9.14
	1300	0.28	5.12	0.40	9.48	0.44	8.83	0.56	5.12
	1900	0.31	4.83	0.39	9.14	0.40	8.53	0.60	8.83
29	0100	0.20	9.48	0.30	9.14	0.35	8.83	0.52	8.83
	0700	0.25	12.80	0.32	8.83	0.36	9.48	0.49	8.26
	1300	0.25	5.02	0.35	10.24	0.39	8.83	0.47	5.82
	1900	0.33	2.56	0.44	13.47	0.41	8.83	0.50	8.83
30	0100	0.29	5.69	0.41	12.80	0.42	12.80	0.57	5.69
	0700	0.27	6.09	0.35	8.53	0.35	9.48	0.52	6.24
	1300	0.38	3.12	0.53	8.83	0.50	3.61	0.88	4.57
	1900	0.48	4.83	0.70	4.83	0.67	7.31	0.98	5.95
31	0100	0.48	7.53	0.61	7.53	0.68	7.31	1.04	7.11
	0700	0.46	8.53	0.62	8.53	0.75	7.53	1.08	8.83
	1300	0.60	8.53	0.88	4.66	0.79	8.00	1.04	8.53
	1900	0.56	5.57	1.00	8.83	0.85	8.00	1.37	8.53
Mean		0.89	8.21	1.24	8.90	1.38	8.74	1.46	8.21
Std dev		0.50	2.76	0.79	2.18	0.98	2.07	0.95	2.04

\* Electronic problems

(Sheet 2 of 2)

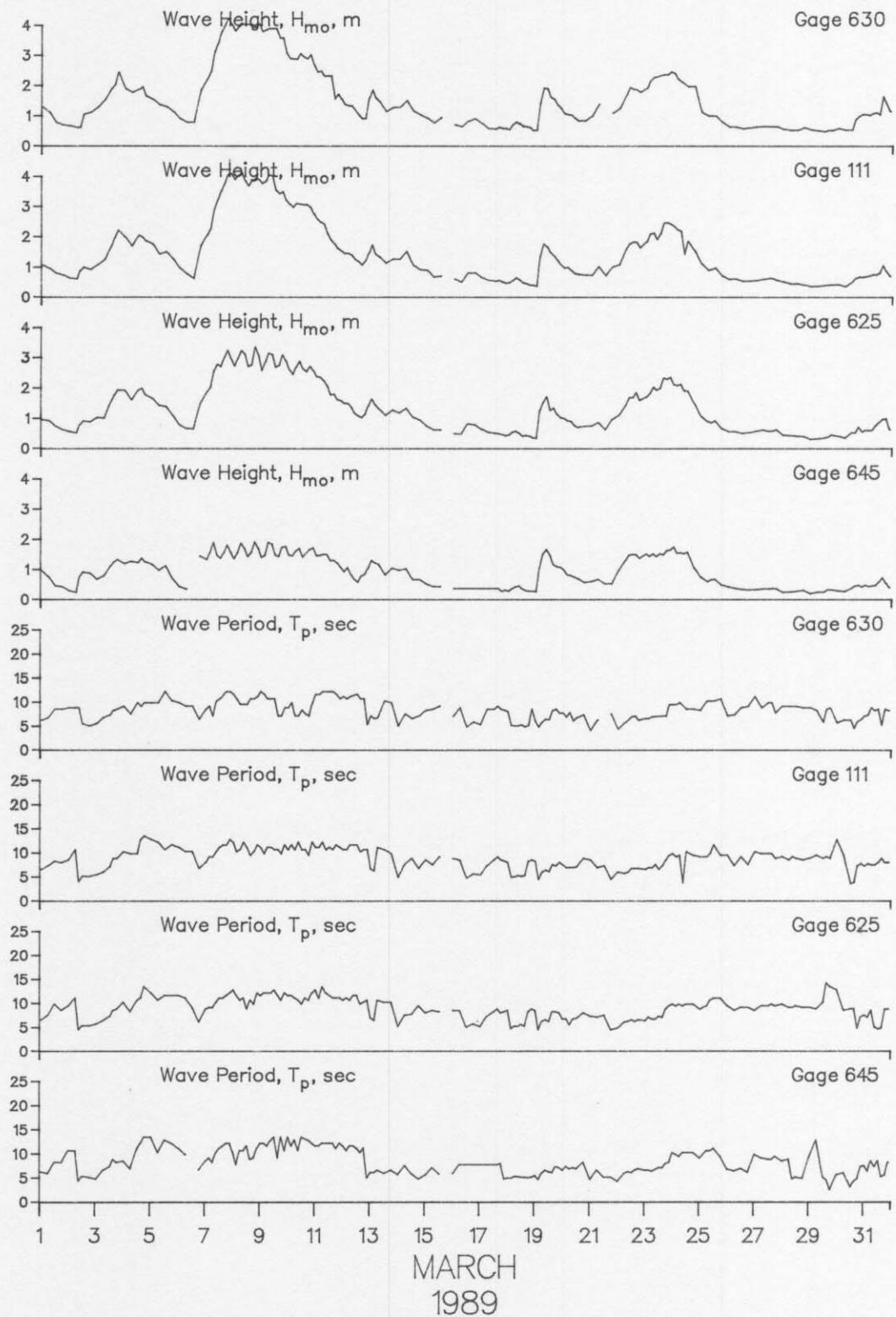


Figure 3. Time history of wave heights and periods

#### PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data  
Mar 1989

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)	Speed	Dir	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
1 0100-Along Cross Result										
1 0700-Along Cross Result	20 3 21	S off 151		153	28 24 36	S on 200		North	47	S
1 1300-Along Cross Result										
1 1900-Along Cross Result										
2 0100-Along Cross Result										
2 0700-Along Cross Result	12 16 20	S on 213		152	18 22 29	S on 210		North	21	S
2 1300-Along Cross Result										
2 1900-Along Cross Result										
3 0100-Along Cross Result										
3 0700-Along Cross Result	15 13 20	S on 202		210	19 10 21	S on 187		South	19	N
3 1300-Along Cross Result										
3 1900-Along Cross Result										
4 0100-Along Cross Result										
4 0700-Along Cross Result	44 22 49	S off 133		189	13 3 14	S off 146		North	89	S
4 1300-Along Cross Result										
4 1900-Along Cross Result										
5 0100-Along Cross Result										
5 0700-Along Cross Result	4 1 4	S off 146		177	21 5 22	S on 174		North	69	N
5 1300-Along Cross Result										
5 1900-Along Cross Result										

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1989

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)				Dye 12m offshore (surface)		Location	Speed	Dir
Day	Speed	Dir	Distance from Baseline (m)		Speed	Dir			Speed	Dir	
6 0100-Along Cross Result											
6 0700-Along Cross Result	20 5 20	S on 174	177		17 4 17	S off 146		19	N		
6 1300-Along Cross Result											
6 1900-Along Cross Result											
7 0100-Along Cross Result											
7 0700-Along Cross Result	30 23 38	S on 197	207		87 87 123	S on 205		4	S		
7 1300-Along Cross Result											
7 1900-Along Cross Result											
8 0100-Along Cross Result											
8 0700-Along Cross Result	34 14 36	S on 182		no observation				no observation			
8 1300-Along Cross Result											
8 1900-Along Cross Result											
9 0100-Along Cross Result											
9 0700-Along Cross Result	87 0 87	S on 160	408		51 102 114	S on 223		no observation			
9 1300-Along Cross Result											
9 1900-Along Cross Result											
10 0100-Along Cross Result											
10 0700-Along Cross Result	38 11 40	S on 177	223		19 31 37	S on 219		no observation			
10 1300-Along Cross Result											
10 1900-Along Cross Result											

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1989

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Speed   Dir		Dye 12m offshore (surface) Location   Speed   Dir			Speed	Dir
Day	Speed	Dir	Speed	Dir	Speed	Dir	Location	Speed	Dir		
11 0100-Along Cross Result											
11 0700-Along Cross Result	68	S on	207	18 1 18	S off 157		North	47	N		
11 1300-Along Cross Result											
11 1900-Along Cross Result											
12 0100-Along Cross Result											
12 0700-Along Cross Result	0 5 5		165	28 11 30	N off 2		South	68	S		
12 1300-Along Cross Result											
12 1900-Along Cross Result											
13 0100-Along Cross Result											
13 0700-Along Cross Result	13 0 13	S 160	189	23 0 23	S 160		North	9	N		
13 1300-Along Cross Result											
13 1900-Along Cross Result											
14 0100-Along Cross Result											
14 0700-Along Cross Result	47 7 47	S off 151	201	10 17 20	N off 39		South	40	S		
14 1300-Along Cross Result											
14 1900-Along Cross Result											
15 0100-Along Cross Result											
15 0700-Along Cross Result	29 22 36	N off 17	143	25 0 25	N 340		South	15	N		
15 1300-Along Cross Result											
15 1900-Along Cross Result											

Gage Inoperative

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1989

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Speed Dir		Dye 12m offshore (surface) Location		Speed Dir		
Day	Speed	Dir	Speed	Dir	Speed	Dir	Location	Speed	Dir	Speed	Dir
16 0100-Along Cross Result											
16 0700-Along Cross Result	25 10 27	S on 182		140	14 20	S on 205			22	N	
16 1300-Along Cross Result											
16 1900-Along Cross Result											
17 0100-Along Cross Result											
17 0700-Along Cross Result	15 13 20	N on 300		140	38 30 49	N on 301	South		3	N	
17 1300-Along Cross Result											
17 1900-Along Cross Result											
18 0100-Along Cross Result											
18 0700-Along Cross Result	0 20 20			152	47 0 47	N 340	South		18	N	
18 1300-Along Cross Result											
18 1900-Along Cross Result											
19 0100-Along Cross Result											
19 0700-Along Cross Result	27 40 48	S on 216		189	27 8 28	S on 177	North		51	S	
19 1300-Along Cross Result											
19 1900-Along Cross Result											
20 0100-Along Cross Result											
20 0700-Along Cross Result	76 38 85	S on 187		140	55 83 100	S on 216	North		24	S	
20 1300-Along Cross Result											
20 1900-Along Cross Result											

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1989

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Dye 12m offshore (surface)		Location	Speed	Dir	Speed	Dir
Day	Speed	Dir	Speed	Dir	Speed	Dir	Location	Speed	Dir	Speed	Dir
21 0100-Along Cross Result											
21 0700-Along Cross Result	51 25 57	N off 7	140		102 20 104	N off 351	South	3	N		
21 1300-Along Cross Result											
21 1900-Along Cross Result											
22 0100-Along Cross Result											
22 0700-Along Cross Result	32 24 40	S on 197	165		102 51 114	S on 187	North	32	S		
22 1300-Along Cross Result											
22 1900-Along Cross Result											
23 0100-Along Cross Result											
23 0700-Along Cross Result	16 12 20	S on 197	201		47 9 48	S on 171	North	34	S		
23 1300-Along Cross Result											
23 1900-Along Cross Result											
24 0100-Along Cross Result											
24 0700-Along Cross Result	7 0 7	S on 160	250		44 13 45	N on 323	South	23	N		
24 1300-Along Cross Result											
24 1900-Along Cross Result											
25 0100-Along Cross Result											
25 0700-Along Cross Result	51 5 51	S on 166	140		41 6 41	S on 169	North	9	S		
25 1300-Along Cross Result											
25 1900-Along Cross Result											

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1989

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
Day										
26 0100-Along Cross Result										
26 0700-Along Cross Result	22 7 off	N 152		9 1 off	N 9			South	9	N
26 1300-Along Cross Result										
26 1900-Along Cross Result										
27 0100-Along Cross Result										
27 0700-Along Cross Result	6 2 off 6 357	N 140		0 51 51	N on 250			South	17	N
27 1300-Along Cross Result										
27 1900-Along Cross Result										
28 0100-Along Cross Result										
28 0700-Along Cross Result	9 8 off 12 19	N 152		12 15 19	N off 32			South	8	N
28 1300-Along Cross Result										
28 1900-Along Cross Result										
29 0100-Along Cross Result										
29 0700-Along Cross Result	12 12 off 17 25	N 152		16 13 21	N off 19			South	22	N
29 1300-Along Cross Result										
29 1900-Along Cross Result										
30 0100-Along Cross Result										
30 0700-Along Cross Result	36 23 off 43 13	N 152		44 20 48	N off 4			South	40	N
30 1300-Along Cross Result										
30 1900-Along Cross Result										

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Concluded)  
Mar 1989

Alongshore Cross-shore Resultant ----- Time	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter		
	Dye at (579 m) (surface)	Distance from Baseline (m)	Dye at Mid-Surf Zone (surface)	Speed	Dir	Location	Speed	Dir		619m Offshore Depth -4.8m (NGVD) ID #679	Speed	Dir
Day	Speed	Dir										
31 0100-Along Cross Result												
31 0700-Along Cross Result	16 12 20	N off 17	165	38 19 43	N off 7	South	57	N				
31 1300-Along Cross Result												
31 1900-Along Cross Result												

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

#### PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Mar 1989

Day	Time	Wave Approach Angle at Pier End		Radar Wave Angle deg from True N	Width of Surf Zone,m	Water Characteristics at Pier End		
		Primary	Secondary			Temp.,C	Density g/cc	Secchi Vis.,m
1	0749	40		39	16	4.5	1.0230	0.9
2	0751	20		45	32	6.1	1.0230	1.2
3	0800	95		60	218	5.8	1.0228	1.5
4	1121	50		inoperative	293	5.6	1.0220	1.5
5	1125	50		40	223	5.4	1.0232	0.6
6	1043	15		inoperative	119	6.1	1.0244	1.5
7	0928	20	45	inoperative	655	5.8	1.0230	0.3
8	0816	20		inoperative	811			
9	0901	50	20	25	811	4.4	1.0230	0.3
10	0845	45	35	45	500	3.9	1.0218	0.3
11	0838	50	90	60	347	4.4	1.0236	0.3
12	0830	85		85	187	5.2	1.0230	0.6
13	0831	45		60	244	5.0	1.0230	1.5
14	0700	85	45	85	213	5.3	1.0216	0.9
15	0706	95			18	5.8	1.0220	0.6
16	0714	20	30	65	3	5.0	1.0248	0.9
17	0716	35			12	5.8	1.0236	2.1
18	0846	110			30	7.2	1.0244	0.9
19	0847	25		45	219	5.6	1.0264	0.3
20	0856	45		55	21	6.6	1.0246	1.8
21	0712	100	130	45	26	7.2	1.0234	2.1
22	0724	40	25	30	189	6.4	1.0240	0.3
23	0824	35	50	55	292	6.1	1.0234	0.3
24	0931	80	40	50	265	6.8	1.0224	0.9
25	0855	70		70	26	7.8	1.0232	2.1
26	0940	60			24	8.8	1.0240	1.2
27	0740	85	15		32	9.4	1.0234	1.5
28	0746	85			3	10.0	1.0220	2.1
29	0725	125			5	8.4	1.0252	1.5
30	0742	90	120		9	8.9	1.0254	3.0
31	0735	110			12	10.0	1.0254	2.4

## PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

## FRF Tide Heights

Mar 1989

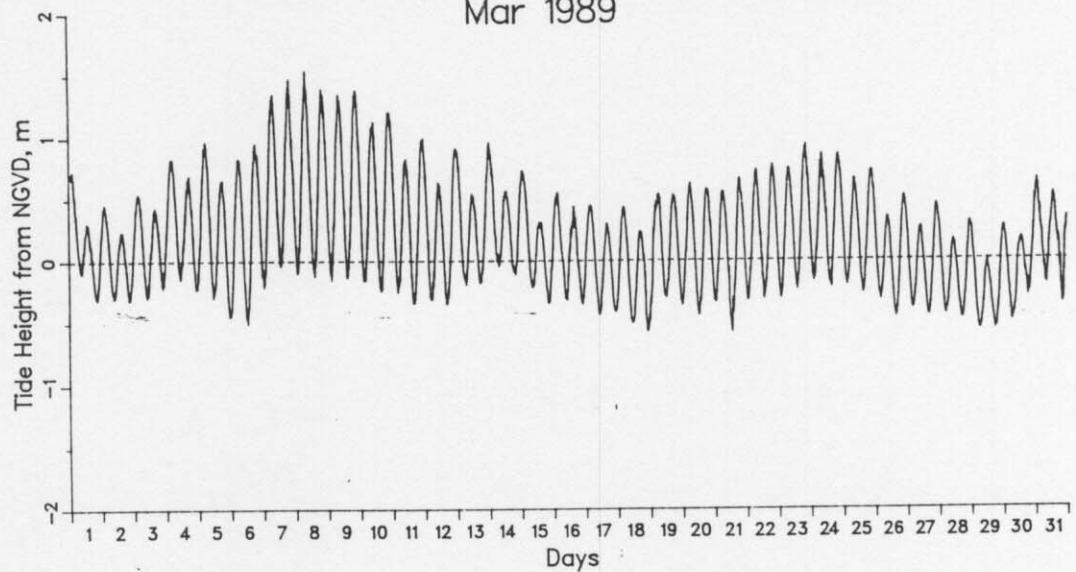


Figure 4. Water level time history

### Monthly Water Levels, m NGVD

Extreme Low = -0.58 on day 21 at 1254 EST  
Extreme High = 1.54 on day 8 at 742 EST  
Monthly Mean = 0.19  
Mean Low = -0.31  
Mean High = 0.71  
Mean Range = 1.01

Table 6: Water Levels, m NGVD

		Mar 1989			
Mid-Cycle Day	Time	Low	High	Mean	Range
1	612	-0.10	0.73	0.26	0.82
1	1837	-0.31	0.39	0.00	0.70
2	703	-0.30	0.46	0.04	0.76
2	1928	-0.32	0.42	0.01	0.73
3	753	-0.30	0.54	0.12	0.84
3	2018	-0.22	0.65	0.17	0.87
4	843	-0.15	0.83	0.33	0.97
4	2109	-0.23	0.69	0.24	0.92
5	934	-0.30	0.97	0.31	1.26
5	2159	-0.45	0.65	0.12	1.10
6	1024	-0.51	0.83	0.19	1.34
6	2249	-0.21	1.00	0.42	1.21
7	1115	-0.04	1.34	0.64	1.38
7	2340	-0.10	1.47	0.65	1.57
8	1205	-0.12	1.54	0.65	1.66
9	30	-0.16	1.39	0.62	1.55
9	1255	-0.13	1.34	0.61	1.48
10	121	-0.16	1.38	0.56	1.54
10	1346	-0.24	1.12	0.45	1.37
11	211	-0.26	1.20	0.46	1.46
11	1436	-0.34	0.82	0.25	1.17
12	301	-0.31	0.99	0.28	1.30
12	1527	-0.35	0.76	0.16	1.11
13	352	-0.19	0.91	0.33	1.10
13	1617	-0.18	0.70	0.22	0.88
14	442	-0.04	0.96	0.39	1.00
14	1707	-0.11	0.56	0.24	0.67
15	532	-0.21	0.73	0.23	0.94
15	1758	-0.34	0.31	0.02	0.66
16	623	-0.32	0.55	0.12	0.87
16	1848	-0.35	0.44	0.03	0.79
17	713	-0.44	0.45	0.02	0.88
17	1938	-0.41	0.30	-0.07	0.71
18	804	-0.50	0.43	-0.05	0.94
18	2029	-0.57	0.23	-0.14	0.81
19	854	-0.30	0.53	0.13	0.83
19	2119	-0.36	0.53	0.10	0.89
20	944	-0.44	0.62	0.08	1.06
20	2210	-0.34	0.58	0.13	0.91
21	1035	-0.58	0.55	0.03	1.13
21	2300	-0.33	0.66	0.17	0.98
22	1125	-0.31	0.73	0.21	1.05
22	2350	-0.31	0.77	0.23	1.08
23	1216	-0.24	0.74	0.28	0.98
24	41	-0.17	0.94	0.35	1.10
24	1306	-0.22	0.86	0.32	1.08
25	131	-0.20	0.85	0.30	1.05
25	1356	-0.27	0.66	0.20	0.92
26	222	-0.32	0.73	0.15	1.05
26	1447	-0.46	0.45	-0.03	0.91
27	312	-0.40	0.52	0.03	0.91
27	1537	-0.45	0.43	-0.07	0.87
28	402	-0.44	0.45	-0.05	0.89
28	1628	-0.48	0.29	-0.15	0.77
29	453	-0.56	0.31	-0.20	0.87
29	1718	-0.56	0.22	-0.25	0.78
30	543	-0.50	0.27	-0.13	0.77
30	1808	-0.29	0.52	0.03	0.81
31	634	-0.20	0.65	0.21	0.84
31	1859	-0.36	0.53	0.15	0.89

## PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in February and four surveys in March on profile line 188, located 517 m south of the pier. The 12 March survey followed a powerful storm on 7-11 March and shows dramatic changes to the offshore portion of the profile. The nearshore storm bar (250 to 390 m) moved seaward 190 m by 12 March but had redeveloped by 28 March. This seaward movement caused significant deposition (up to 0.75 m) over the seaward 400 m of the profile, a region which generally experiences only minor changes. Only minor changes occurred near the NGVD intercept (120 m). This stability may have resulted from an intense storm in late February (as documented by the 27 February survey) which had already caused severe erosion of this area. The last survey in March shows the development of a new post-storm berm on the beach face.

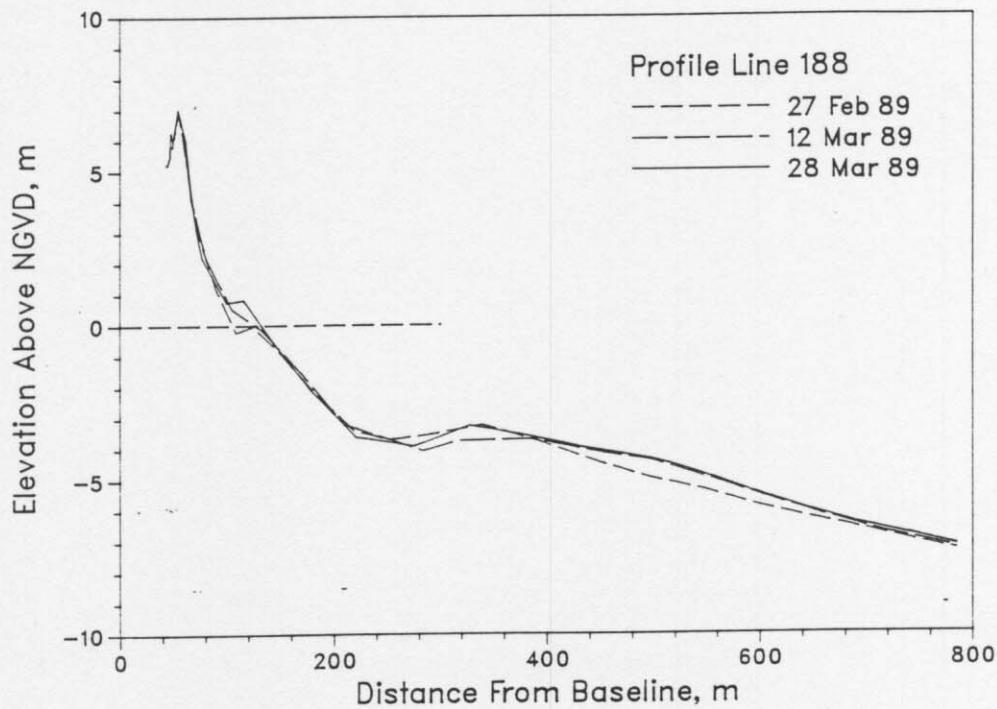


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1989. The storm is well documented in the envelope which shows the huge amount of offshore deposition and the removal of the storm bar (200 to 320 m). Also visible is the large berm (140 m) created at the end of the month.

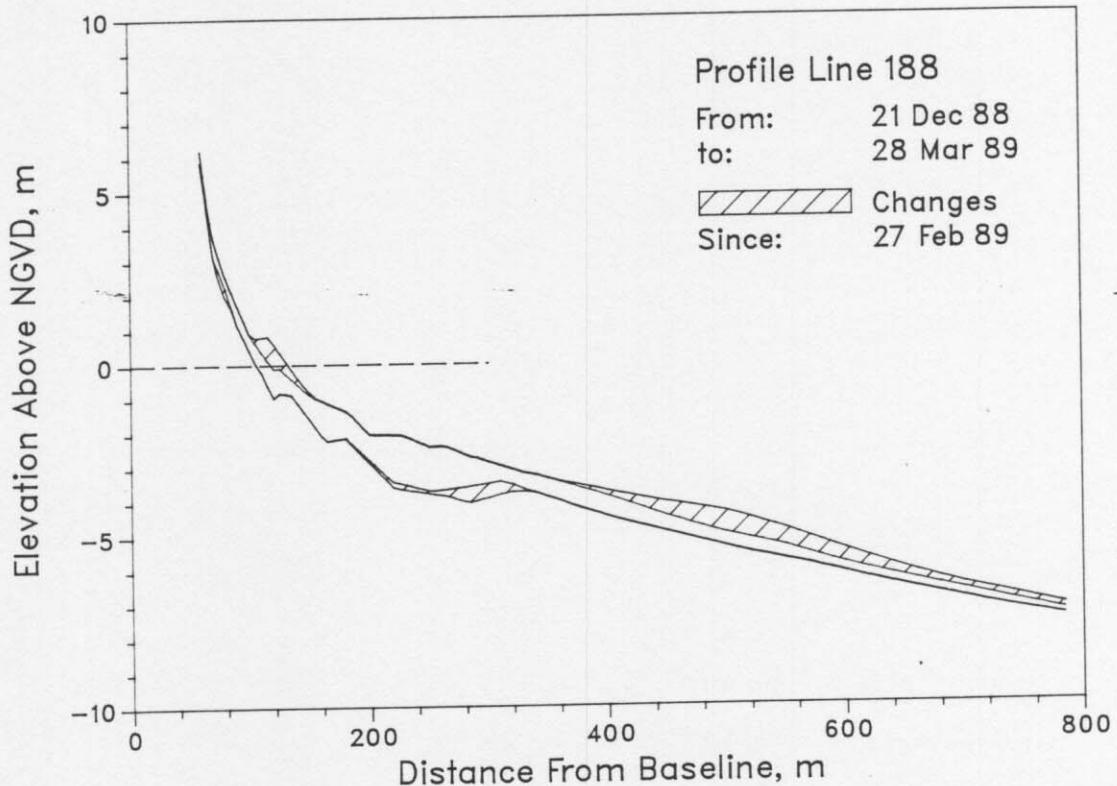
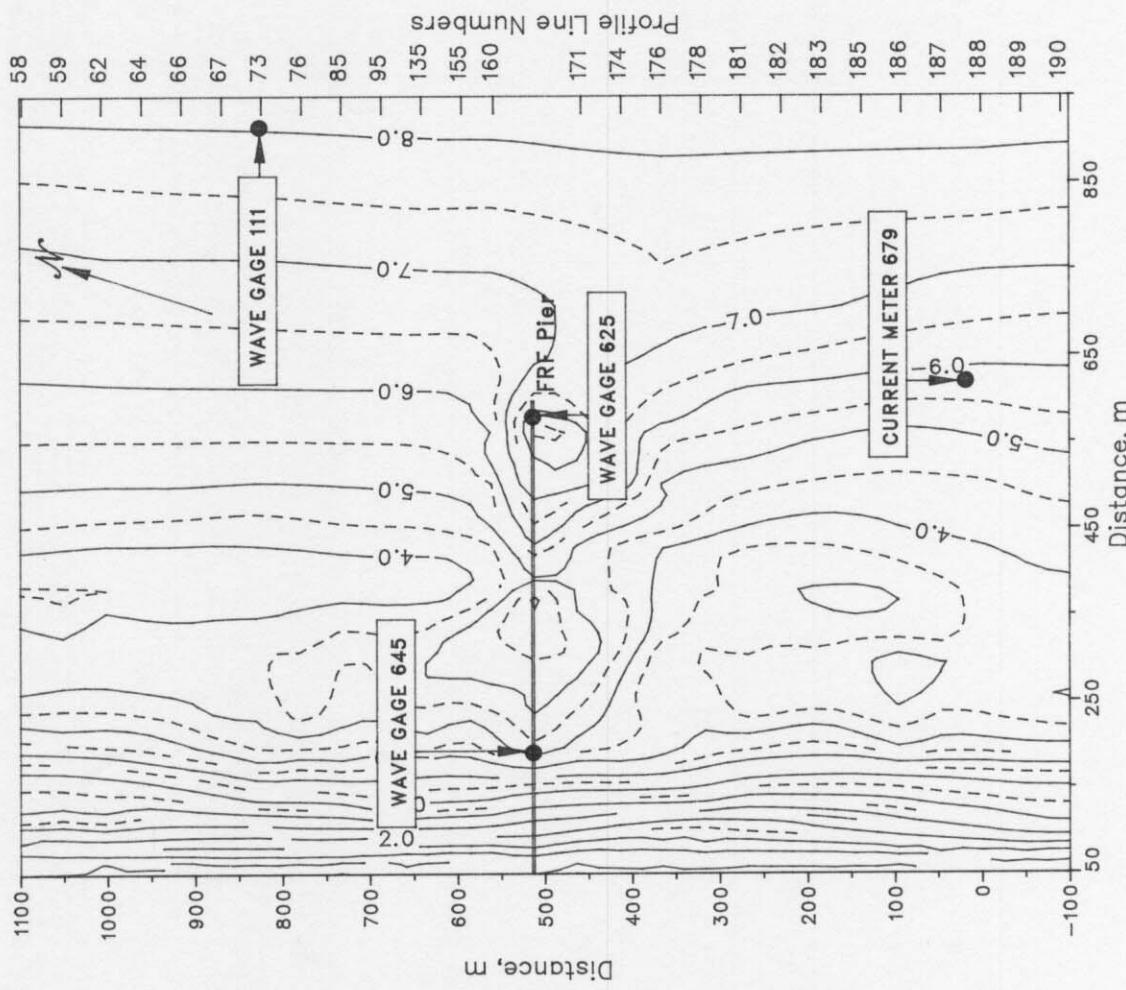
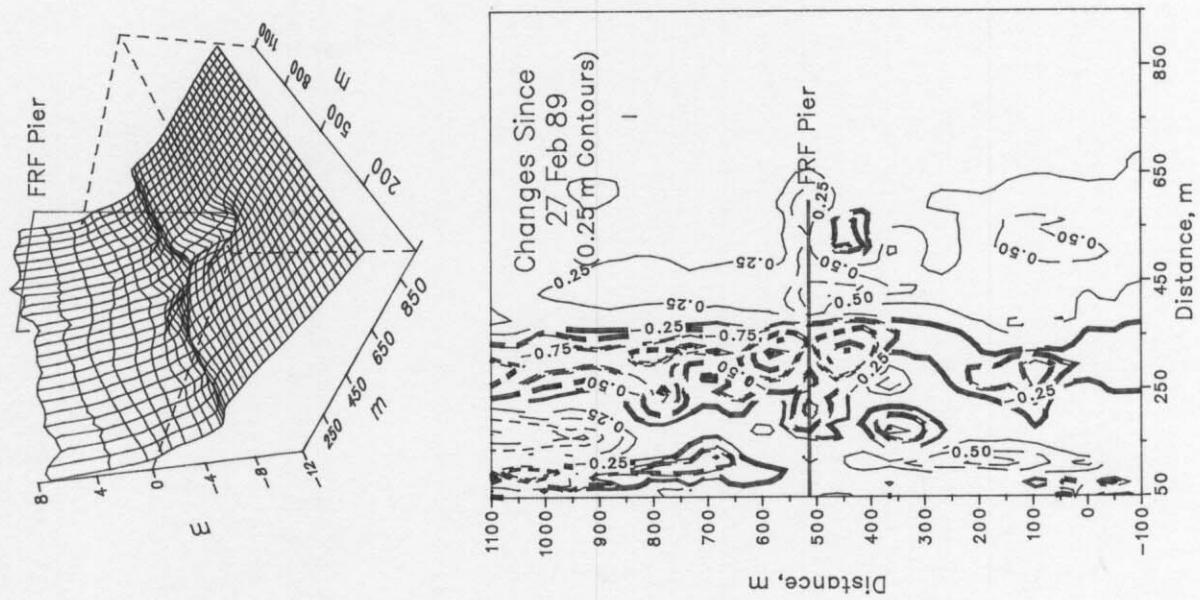


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 12 March. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition. The major shift of material offshore caused by the early March storm is clearly evident.



**FIGURE 7 . FRF BATHYMETRY 12 Mar 89  
(Depths Relative to NGVD)**

## PART VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the significant wave height at the seaward end of the pier (i.e. as measured at the end of the pier) exceeded 2 m and four contiguous 34 minute wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
7 Mar (0208)	11 Mar (2342)
23 Mar (0700)	24 Mar (0808)

### B. Storm Synopsis.

7-11 March - Forming over Alabama early on 6 March this complex storm moved off the North Carolina coast on 7 March and promptly stalled. Forming on a stationary front over the Florida Keys a secondary low pressure system quickly intensified as it crossed Florida and moved into the Atlantic. Blocked by a Canadian high pressure system the storm slowly moved up the coast finally stalling off the Georgia coast on 8 March. Reforming again off the Florida coast the low retraced its previous slow northeasterly movement up the coast. By 10 March the storm was located off the Georgia coast; changed direction and moved offshore. By 11 March the storm no longer threatened the coastline. Maximum wind speeds (from north-northeast) approached 18 m/s at 0242 EST on 8 March. However, onshore winds exceeding 15 m/s lasted for 59 consecutive hr. The maximum  $H_{mo}$  (Gage 111) of 4.23 m ( $T_p = 12.19$  sec) occurred at 1934 EST on 7 March. The minimum atmospheric pressure of 1007.3 mb (this pressure reading indicates that the storm's center was never close to the FRF) was recorded on 6 March at 1442 EST. Precipitation totalled 28 mm.

This storm destroyed or damaged over one hundred cottages and motels along the Outer Banks and as such was the most destructive storm in this area since the infamous "Ash Wednesday" (March, 1962) storm. In addition to the storm's intensity and duration several contributing factors coincided to increase its destructive potential. These included spring tides occurring during the height of the storm and a beach already severely eroded by intense storms in February.

23-24 March - Developing in the Gulf of Mexico on 23 March this storm rapidly travelled up the eastern seaboard arriving over eastern North Carolina early on 24 March and reaching New England the next day. Maximum wind speeds (from northeast) exceeded 14 m/s on 23 March at 1442 EST followed several hours later (2200 EST) by the maximum  $H_{mo}$  (at gage 625) of 2.35 ( $T_p = 9.48$  sec). The minimum atmospheric pressure of 1009.6 mb was recorded on 24 March at 1142 EST. Total precipitation was 60 mm.

### Distribution List

#### Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
SAW	U.S. Naval Research Lab

#### Colleges/Universities:

California Inst. of Tech.	Stockton State College
East Carolina University	University of Akron
Florida Inst. of Tech.	University of Delaware
Harvard University	University of Florida
Naval Post Graduate School	University of Maryland
NC State University	University of Miami
Old Dominion University	University of North Carolina
Oregon State University	University of N. Colorado
Prince George's College	University of Rhode Island
Rutgers University	University of Virginia
Scripps Inst. of Oceanography	Va. Inst. of Marine Science
Southern Illinois University	

#### Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
Coastal and Est. Res., Inc.	Offshore Coastal Technologies
Coastal Science & Eng., Inc.	Mr. Rowland
Dr. Galvin	Mr. Savage
GEOMET Tech., Inc.	Sea Port Supply Corp.
Greenhorne & O'Mara, Inc.	Shell Development
Dr. Hylton	Sherwood Industries
Mary Marr, Inc.	Mr. & Mrs. Valpey
Mr. Mason	WCTI-TV
Masonite Corporation	SEASUN Power Systems

#### Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)  
Queen's University, Ontario (Canada)  
Ministry of Construction, Coastal Division (Japan)  
Norwegian Hydrodynamic Laboratories (Norway)  
University of New South Wales (Australia)  
University of Sydney (Australia)